

Wearing Out – The Decline of Health¹

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March, 2006

The acquisition of chronic diseases and lifestyle choices are key aspects in the decline in health. Case and Deaton(2005) examine the importance of manual work in altering both the level and rate of decline in health status with age. Using data from Canada, our paper extends this analysis by investigating the interaction of manual work with chronic conditions and lifestyle on the aging process. To our surprise, the independent importance of manual work remains even after one accounts for the large role of lifestyle and chronic diseases. In general, the results from Canada are very similar to those found in the United States.

JEL: 110, 112, Morbidity, Aging, Chronic Disease

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¹ We would like to thank Ali Iglesias for her research assistance.

1. Introduction.

In a recent paper, Case and Deaton (2005) provide an interesting interpretation of the decline or ‘wearing out’ of individuals’ health in the United States. ‘Wearing out’ is interpreted as the reduction in self-reported health status² over the life-cycle. Their evidence supports the hypothesis that those in manual occupations ‘wear out’ more rapidly than those in non-manual occupations. Our intent is to investigate this process in Canada and extend their results to include the role of chronic conditions and behavioural variables. Accounting for the role of chronic conditions and lifestyle choices is important given the well documented links between the decline of health status and these lifestyle factors. We find similar evidence in the Canadian data that the ‘wearing out’ effect is greater for manual occupation relative to non-manual occupation. More importantly, the differential rate of decline in health status resulting from occupation remain significant and continue to persist even after accounting for chronic conditions and lifestyle choices. Accounting for these latter factors does reduce the occupational effect.

Figure 1 shows the basic pattern of declining health with age in Canada. Health status is measured by self-reported health status (SRHS) with a larger number indicating poorer health. As expected, as individuals age, their health declines. This reflects the ‘wearing out’ effect discussed earlier.

²There are limitations to all measures of morbidity. Waldron (1983, p 1118) discusses the differences between measures of self reported health and evaluations by doctors. She concludes that differences are quite common but vary with the condition. However, there is no evidence that doctors evaluation of general health is better than those from self evaluations. Idler, E, L. Russell and D. Davis (2000) provide more recent evidence.

Underlying the Case and Deaton analysis is a standard intertemporal utility model³. Only a brief summary will be included here. Grossman's (1972) model of intertemporal healthcare choice is the starting point. At any point in time, health Status, H , evolves according to the equation,

$$H_{t+1} = \theta m_t - (1-\delta_t) H_t$$

Health status, H , depreciates at a rate, δ , with time but this depreciation is offset by purchased investment inputs like medical care, m .⁴ The variable θ captures the efficiency with which medical care improves health status. In empirical studies, content is added by assuming that at least one of the efficiency, θ or the depreciation rate, δ depend on other variables such as income and education.

Case and Deaton are assuming that occupational choice alters the depreciation rate. They follow the work of Muurinen and Legrand (1985) who introduced a model in which individuals have three types of capital – health capital, human capital in the form of education, and financial assets. Health capital deteriorates with age but the deterioration is dependent on how health capital is used in consumption and work. Individuals with less human and financial capital will optimally use up more health capital in maximizing utility. Case and Deaton derive the implications of this model and provide an empirical test.

³They do not estimate a structural model but use the theoretical analysis to motivate the estimated equations.

⁴ In many versions of this model, the purchase of healthcare can completely reverse the decline in the health stock. This is an unrealistic assumption and Case and Deaton consider the implications of relaxing this assumption in a number of special models.

In this paper, we have two objectives. First, we investigate whether the Canadian data supports the results provided for the United States in Case and Deaton (2005). Second, we extend the analysis by considering the important role of chronic conditions, obesity and smoking in reducing health status and possibly altering the US conclusions. Health status decline is known to be linked to the acquisition of chronic conditions and to lifestyle choices. There are two possible roles for lifestyle choices and chronic conditions. First, manual workers may acquire chronic conditions more rapidly or more frequently. In this case, chronic conditions and lifestyle choices underlie the Case and Deaton results. In fact, there may be no independent role for manual work. In the second case, chronic conditions and lifestyle choices may not be the underlying reason for the poorer health of manual workers. However, excluding these variables may distort the parameter estimates of the included variables.

In the next section, we briefly describe the data that we use. This is followed by the main empirical results of the paper in Section Three. Section Four discusses a number of underlying differences in the Canadian and American studies. We extend the model in Section Five to include the impact of a number of medical and lifestyle variables. We find that these are important components of the decline in health but, accounting for these factors does not change the conclusion about the role of manual labour in the decline of health status. We conclude with some suggestions for further research.

2. Data

Our data is taken from Statistics Canada's Canadian Community Health Survey, 2000-01, Cycle 1.1. This national survey has about 130,000 respondents from age 12 to 80+. The institutionalized population is excluded. We use the public micro file which reduces some of the individual detail. Age and Household Income are reported in intervals and we have assigned individuals to the midpoints of the intervals of these variables.

Individuals are asked to report their current health status on a scale from 1 to 5. A high score indicates poor health since the scale is poor – 5, fair – 4, good – 3, very good – 2 and excellent – 1. This is a widely used scale and allows one to observe the decline in health status as the population ages.

Our focus is on the role of manual labour in influencing the decline in health. For this reason, we restrict the sample to those age 20 to 60 for most of the econometric analysis. The means of the variables for this sub-sample are shown in Table One. The manual occupations are Trades and Transportation, Farm, Forest and Fishery, Processing/Manufacturing and Other.

3. Canadian Empirical Results

Figure 1 shows the decline in average self-reported health for males and females as they age. There is very little difference between the sexes except that young females report worse health than young males. If one considers the decline in health by income quartiles⁵, the pattern changes sharply. In Figure 2 we show the patterns of aging for the highest and lowest income

quartile by sex. This diagram inspired Case and Deaton to investigate the role of occupation or manual labour in the decline of health. The Canadian pattern in Figure 2 is very similar to the American one. Notice that twenty year olds in the bottom income quartile have levels of health that are equivalent to sixty year olds in the top quartile. It takes forty years for individuals in the top quartile to reach the health status of twenty year olds in the bottom quartile.

There are three features of Figure 2 that require comment. First, there is a health status gap even at the youngest age group. Second, and central to the Case-Deaton paper, is the very rapid rise in poor health amongst the lowest income quartile in the age range 20 to 60 compared to the highest income quartile. The third is the ‘catching up’ of individuals in the top quartile after age sixty. Having delayed ‘wearing out’ for several decades, those in the top quartile experience more rapid health declines after 60 and their health status move toward the level of those in the lowest income quartile. At the age of 75, higher income individuals remain in better health than those with low income. This gap is larger in Canada than the US. In the US, the gap almost closes.

Individuals in the bottom quartile begin their adult life in worse health than those in the top quartile. The acquisition of poor health during childhood has been investigated recently by Case et al (2002 and 2003) and by Currie and Stabile (2003). The gap we observe is consistent with the evidence from these papers. Their research suggests that some of what we observe in the older working age population is a consequence of health differentials that began before age 20.

⁵The quartiles are adjusted for household size.

Neither this paper or Case and Deaton focus on the ‘catching up’ of high income individuals with the poorer health of the low income individuals after age 60. The presumption is that this is simply the non-reversible aging process. We do not investigate reasons for the very flat health status amongst low income individuals after age 55.

From age twenty to sixty, individuals in the lowest income quartile have rapidly deteriorating health and those in the top quartile do not. This is the period during which working in different occupations may ‘wear out’ individuals at different rates. Based on the Case and Deaton analysis, we want to know if people in manual occupations have lower levels of health and higher rates of decline in health. The results for health levels are obtained from the ordered probit regression of SRHS on income, education, and occupation. Controls are included for age, race and gender. The results are shown in Table 2 for males and females separately and for the whole sample. Higher levels of household income and education protect both males and females from declining health status. Females benefit slightly more than males from both these factors.

The contribution of occupations to health levels is shown in both Table 2 and Figure 3. The omitted occupation is Management. The Non-Manual occupations are Management, Professional, Technologist, Administrative/Financial, and Sales and Service. The coefficients for males and females in a given occupation are quite similar. The differences are larger across occupations than across gender. This suggests that there is an occupational effect independent of gender, education, age, income and race. This same pattern was found in the United States.

In both the US and Canada, manual occupations tend to have a larger negative impact on health than non-manual occupations. In both countries, there are exceptions. In Canada, the most notable exception is the relatively high levels of health in Farming and Forestry. Similar results

were found in the United States for the three groups: Farming/Fishing, Construction and Fire/Police. In both countries, these results probably reflect the selection process both into and out of these occupations.

The Canadian evidence supports the US finding of a negative impact of manual labour on the level of health. The second question is the impact of manual labour on the rate of decline in the health stock. For the US, there is evidence that manual labour increases the rate of decline in health for both males and females. The Canadian results are shown in Table 3.

Higher incomes and levels of income protect individuals from health declines. In Table 3, incomes and levels of education are interacted with age. Does this protection change as individuals age? Higher incomes lead to better levels of health and these higher incomes slow down the decline in health with age. Both males and females benefit from the higher incomes but females seem to receive a larger improvement in slowing the rate of health decline. The US results are similar except for the absence of any gender differential in the health decline process.

Higher education improves the level of health at any age for both males and females, but has little impact on the rate of decline in health. There is a small improvement in the rate of decline for males, however the coefficient is insignificant for females. In both the US and Canada, higher incomes provide more protection against aging than does higher education but both raise the level of health.

In Table 3, the rate of health deterioration does increase with manual labour for males but not for females. Our results from the Canadian data confirms the US results for males but contrast with the US results for females who also experience an increased rate of health decline with manual occupation. We suspect that the difference for Canadian relative to American

females may arise from the occupational classification available in Canada. This is discussed further in the next section. How large are the impacts of manual labor on health status? We consider the effect of manual labor on the probability of being in a particular health state for 40 and 50 year old middle income white males and females in Table 4. The effects of working manual labor jobs are largest at the both ends of the self reported health spectrum. For a randomly chosen 40 year old individual, manual labor on average lowers the probability of being in very good or excellent health by around 15 % and increases the probability being in poor health by around 21 %. This likelihood of being in poor health as a result of manual work increases slightly with age for males but decreases for females.

Figure 2 showed a dramatic decline in health in the lowest income quartile relative to the top quartile. There is strong evidence in both countries that this is related to health-based selection. The Canadian data is shown in Figure 4 for males only. The sample is divided into those who are employed and those who are not employed.⁶ The bottom two lines show the decline in health for those who are employed in the top and bottom quartiles. While those in the bottom income quartile are in worse health, there is no dramatic decline in their health between the ages 20 to 40 as in Figure 2. For the employed, there is a health differential between those in the top and bottom household income quartiles. This difference however does not show the pattern observed in Figure 2.

⁶The ‘unemployed’ are mostly out of the labour force. The Canadian survey does not allow us to consider only those out of the labour force. The latter definition was used in Case and Deaton.

The top line in Figure 4 is for males in the bottom quartile⁷ who are unemployed and/or out of the labour force. It is this group that experiences the rapid decline in health between age 20 and 40. This same pattern occurs for American males who are not in the labour force. The dramatic decline in health shown in Figure 2 is not due to manual labour directly. There is a role for manual labour but it is smaller than the sharp decline shown in Figure 2. This decline seems to be a flow from poor health to low income and not the reverse. Poor health may have originated from factors on the job but we are not able to observe these origins.

4. Comparing the Canadian and American Results

Overall the broad conclusions from Case and Deaton are supported by the Canadian evidence. There are some differences which will provide puzzles for future researchers. First, Case and Deaton suggest that females have worse health than males until about age sixty and that this is widely observed in many samples. This pattern is not observed in Canada although we have no explanation.

Second, in the US, the rate at which health declines seems to fall after age sixty but this is not evident in Canada.

Third, there is only one cross section in the Canadian data while the US study uses sixteen. The sample size of the Canadian cross section is not an issue since relative to the

⁷The line for those in the top quartile who are not working is excluded. Since we are using quartiles for the whole sample, there are too few males with high incomes and no employment.

population, the Canadian data is larger than the combined US samples. The main US results do not depend on the presence of multiple years.

The definitions of the occupations differ between the two countries and they cannot be changed to match. The classification differences are not important for our results with perhaps one exception. We found no support amongst females for more rapid health declines among manual workers. The US data does support more rapid health deterioration for females in manual occupations. In the Canadian data, there is one occupational classification that combines Sales and Services occupations. We include it in the manual labour category of occupations. In the US data, there are two categories – Sales and Services. In the Case-Deaton paper, Sales occupations are included in the non-manual category and Service occupations in the manual occupation category. For the US, the coefficient on the impact on SRHS for Sales is much smaller than for Services. Since we cannot divide these occupations, we have left them in the non-manual group but this may be the source of the difference in the Canadian and US results.

There is one aspect of the American study that cannot be duplicated for Canada. In both countries, panel data would be very useful to investigate the selection out of occupations due to health problems. Neither study has a panel. Case and Deaton's research uses the sixteen cross sections in their data to analyse birth cohorts by occupation. They find some evidence of selection at the occupation level for manual but not non-manual occupations. Health declines with age for both groups but is only for manual workers that the size of cohort declines as health declines. These results cannot be duplicated with the single Canadian cross-section.

The Canadian results do not support some of the gender differentials⁸ found in the United States. This suggests that there is a need for a more careful analysis of whether gender differentials have any role in health decline.

5. The Influence of Chronic Conditions, Smoking and Obesity

Given that an individual is alive, the most likely sources of less than excellent health are chronic conditions and life-style decisions such as obesity and smoking. Case and Deaton establish that US manual workers have worse self reported health than non-manual workers after controlling for other variables. They interpret this as evidence that the flow is from health to low incomes and not the currently fashionable notion of a reverse flow of low incomes to poor health.

Accepting the Case and Deaton evidence leads to the following question. What role do chronic conditions play in the relatively poor health of manual workers? One possible answer is that manual workers acquire chronic conditions at a more rapid pace than non-manual workers. These chronic conditions result in relatively poor self-reported health. Suppose the development of chronic conditions is the major source of poor health for manual workers. If we include a measure of chronic conditions in the regression, the coefficient on manual work should fall.

⁸A more detailed review of gender differences in morbidity can be found in Waldron (1983) and Case and Paxson (2005).

Our evidence suggests that chronic conditions⁹ have a large impact on self-reported health but these conditions do not explain the poorer health of manual workers. This evidence is shown in Figure 5. The average number of chronic conditions increases with age for both males and females. Females have more chronic conditions than males at all ages. However, manual workers do not have more chronic conditions than non-manual workers for either gender. For females, non-manual workers have more chronic conditions than manual workers prior to age sixty.

Chronic conditions are not the only source of poor health. Both obesity and smoking reduce individual's self-reported health status. In both the theoretical and empirical sections, Case and Deaton note that the poorer health of manual workers is due to their consumption habits as well as their manual work. Smoking and obesity are two conditions that are linked to consumption choices. Unlike chronic conditions, there is a higher incidence of both obesity and smoking among manual workers. The differential is larger for smoking than for obesity.

At age twenty, about three percent more manual workers are daily smokers than non-manual workers. The percentage rises to fifteen percent for individuals in their forties and then declines again after fifty. Across all ages, the average differential between manual and non-manual workers is ten percent. On average three percent more manual workers are obese and the percent varies from one percent at age 20 to five percent at age 50.

⁹Chronic conditions include asthma, arthritis, diabetes, cancer, heart disease, stroke, allergies, migraines, high blood pressure and a number of less prevalent conditions.

We define three new dummy variables. *Chronic* indicates that an individual has at least three chronic conditions¹⁰. *BMI* indicates that the individual has a body mass index (BMI) greater than 30 which is the usual definition of obesity and *Daily Smoker* indicates that the individual is a daily smoker. These three variables are added to the regression underlying Tables 2. The new results are shown in Table 5. Each of these new variables has a very large and significant impact on health status. Moreover, if the variables are entered individually, the coefficients are very similar to those in Table 5. Each of these conditions has a strong and relatively independent deleterious impact on health status.

The surprising result is that the conclusions from Table 2 are not reversed by the results in Table 5. Chronic conditions, obesity and smoking are very important determinants of health status but there remains an independent role for occupational differences. Occupational effects are reduced in size by about ten percent when the new variables are added but they remain significantly different from zero. In addition, the pattern between manual and non-manual occupations is not disturbed.

5. Conclusions

The results for Canada are similar to those in the United States with only a few exceptions. This confirms Case and Deaton's results that occupational choice influences the process of wearing out. In Canada, the probability of being in poor health is raised by twenty percent for a manual worker at age 40. The Canadian evidence is weaker on the influence of

¹⁰We have used three conditions because some of the chronic conditions are very minor.

manual labour on the rate of decline in health but this may reflect the limitations of the available occupational classifications.

Our results extend the earlier work by investigating the importance of three new factors. Chronic diseases, smoking and obesity are all important factors in developing poor health. The acquisition of chronic diseases is perhaps the most important factor in the development of poor health. It seemed likely *ex ante* that the inclusion of these conditions would eliminate the independent role of occupation. This did not occur although there was a ten percent decline in the size of the coefficients.

As McFadden (2005) noted, the long-run goal is to develop and test models of the depreciation of the health stock. Models that assume that investment in healthcare can eliminate health deterioration are not appropriate. However there are many alternatives to the Case and Deaton's choice of a model with proportional depreciation. We are only at an early stage in our understanding of the most appropriate model of health stock depreciation.

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Table 1. Sample Means, Men and Women Aged 20-60, Canadian Community Health Survey (2000-2001)

	All	Men	Women
Age	40.6	40.5	40.7
Log(income)	9.64	9.65	9.63
Female	0.53		1
Management	0.090	0.114	0.068
Professional	0.133	0.110	0.153
Technologist	0.064	0.090	0.040
Admin/Fin/Clerk	0.099	0.029	0.162
Sales/Service	0.165	0.126	0.200
Trades/Transport	0.127	0.235	0.031
Farm/Forest/Fish	0.046	0.076	0.020
Processing/Manuf	0.038	0.054	0.025
Other	0.051	0.045	0.057
Out of labor force	0.169	0.106	0.224
Observations	89,090	42,044	47,046

All means are weighted using the sample weights provided by the Canadian Community Health Survey 2000-2001

Table 2. Ordered Probit Regression of Self reported Health Status by Occupation for Men and Women aged 20-60 years, Canadian Community Health Survey, 2000-2001

	All	Men	Women
Ln(income)	-0.424 (0.017)	-0.385 (0.024)	-0.462 (0.023)
Education	-0.078 (0.004)	-0.074 (0.006)	-0.088 (0.006)
Professional	-0.045 (0.016)	-0.059 (0.023)	-0.018 (0.024)
Technologist	0.098 (0.019)	0.125 (0.024)	0.052 (0.032)
Admin/Finance	0.061 (0.018)	0.141 (0.034)	0.059 (0.024)
Sales/Service	0.152 (0.016)	0.133 (0.023)	0.169 (0.024)
Trades/Transport	0.216 (0.017)	0.216 (0.021)	0.218 (0.037)
Farm/Forest	0.082 (0.028)	0.091 (0.033)	0.061 (0.053)
Processing/Manuf	0.261 (0.023)	0.244 (0.029)	0.306 (0.037)
Other	0.155 (0.022)	0.170 (0.031)	0.152 (0.030)
Number of observations	65487	33448	32039

Coefficients reported are estimates of the health status expected given this occupation, relative to the omitted category of “Management.” Estimates are based on ordered probits that include indicator variables for age and race. Column one also includes a variable for sex. All ordered probits have been weights using the sampling weights provided by the Canadian Community Health survey. Standard errors are in parentheses.

Table 3: Ordered Probit Regression of Self Reported Health status by manual labor status and gender, aged 20-59

	Men	Women
Manual Labor	0.014 (0.048)	0.249 (0.048)
Manual Labor x age	0.0033 (.0012)	-0.0023 (0.0012)
Log (income)	-0.213 (0.081)	-0.205 (0.077)
Log(income) x age	-0.0047 (0.002)	-.0073 (0.002)
Education	-0.067 (0.020)	-.0127 (0.022)
Education x age	-0.0002 (0.00005)	0.0007 (0.0005)
Age Indicators	Yes	Yes
Race Indicator	Yes	Yes
Observations	33757	32354
Pseudo R square	0.0199	0.0210
Log Likelihood	-42135.275	-40467.243

Notes: Coefficients reported are estimates of the health status expected, relative to Non-Manual workers. Estimates are based on ordered probits. All probits are weighted using weights provided by CCHS. Standard errors appear in parentheses.

Table 4: Marginal effects from ordered probit regression

		Probability of SRHS state		
		Excellent or Very Good (1,2)	Good 3	Fair or Poor (4, 5)
40 year old white male earning 15,000 to 30,000 who completed high school.	ML = 1	0.367	0.404	0.229
	ML = 0	0.423	0.389	0.188
	Change	-0.056	0.014	0.042
	% Change	-13.282	3.690	22.310
40 year old white female earning 15,000 to 30,000 who completed high school.	ML = 1	0.287	0.405	0.308
	ML = 0	0.343	0.402	0.255
	Change	-0.056	0.003	0.053
	% Change	-16.284	0.695	20.799
50 year old white male earning 15,000 to 30,000 who completed high school.	ML = 1	0.280	0.411	0.309
	ML = 0	0.343	0.408	0.249
	Change	-0.063	0.003	0.060
	% Change	-18.424	0.764	24.114
50 year old white female earning 15,000 to 30,000 who completed high school.	ML = 1	0.224	0.395	0.381
	ML = 0	0.266	0.403	0.331
	Change	-0.031	-0.008	0.023
	% Change	-15.878	-1.957	15.131

ML stands for manual labor. Table 4 evaluates the probability of being in different health status at the parameter estimates given in Table 3.

Table Five: Ordered Probit Regression of Health Status on Occupation, and Chronic Conditions

Variable	Coefficient	Stand. Error
Chronic3	0.830	0.017
BMI	0.423	0.014
Daily Smoker	0.273	0.01
Income	-0.351	0.017
Education	-0.065	0.004
Professional	-0.024	0.017
Technologist	0.116	0.019
Admin//Finance	0.055	0.018
Sales/Service	0.142	0.017
Trades/Tech	0.19	0.017
Farm/Forest	0.08	0.028
Proc/Manuf.	0.255	0.023
Other	0.136	0.022
Age, Education, Income Dummies Included		
No. of obs	63396	

Figure One: Self Reported Health Status by age and sex

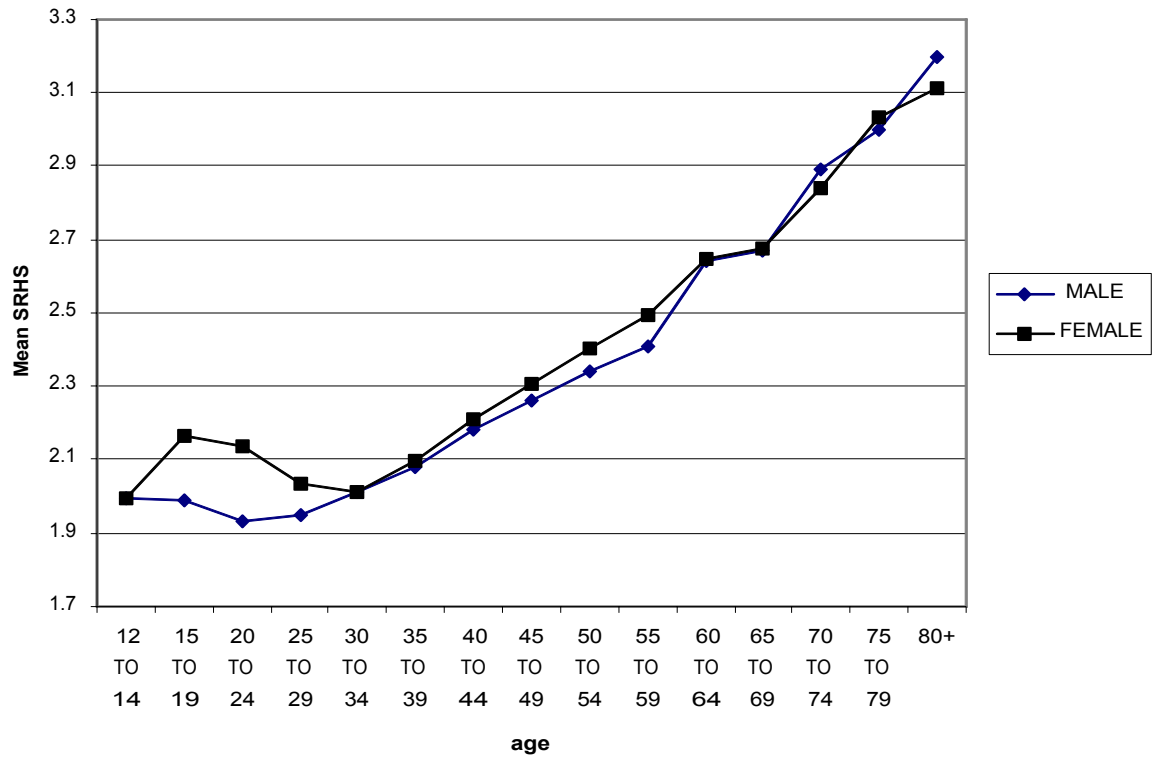


Figure Two: Self Reported Health Status by age, sex and income quartile

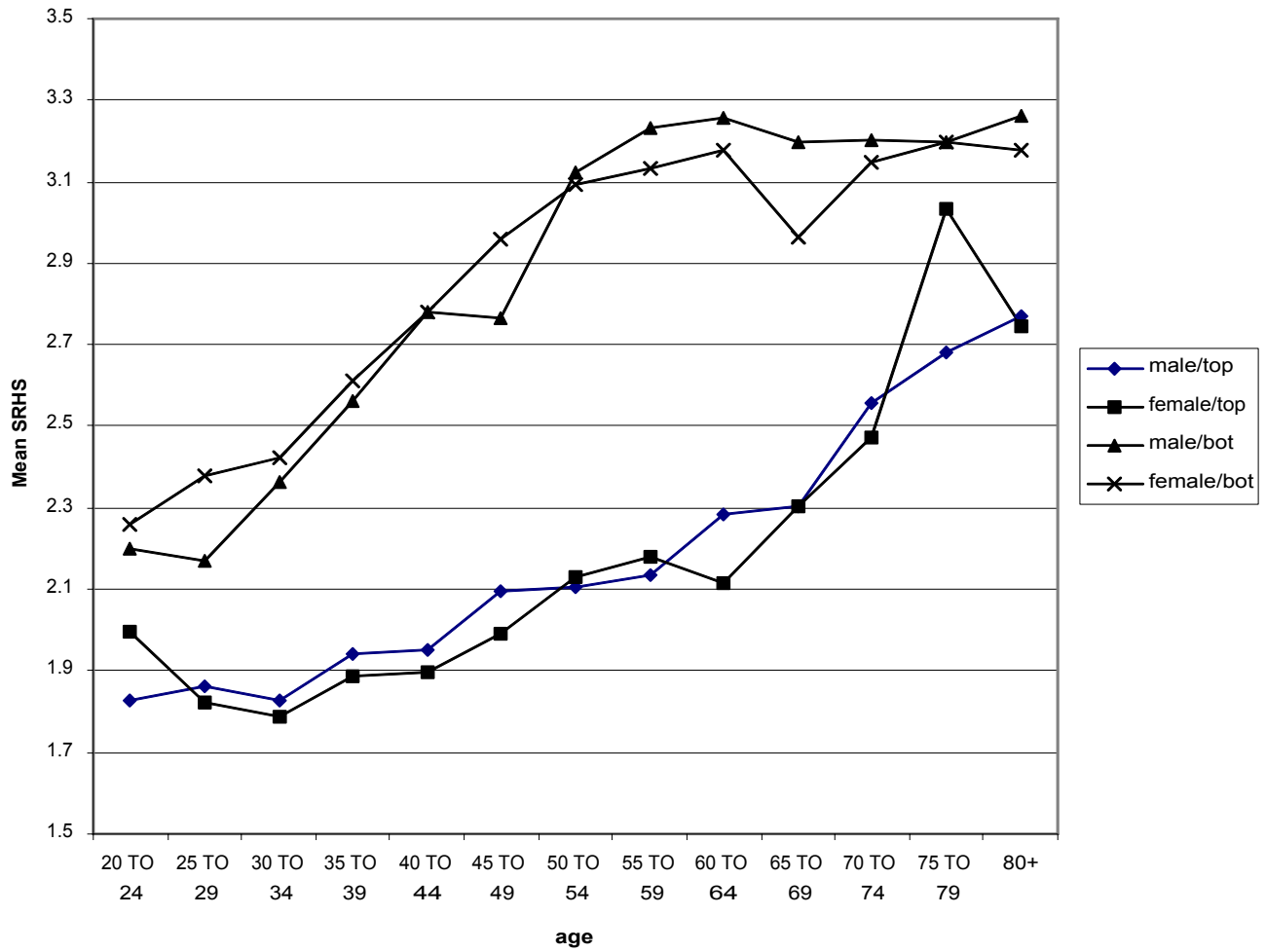


Figure Three: Self Reported Health Status by Occupation

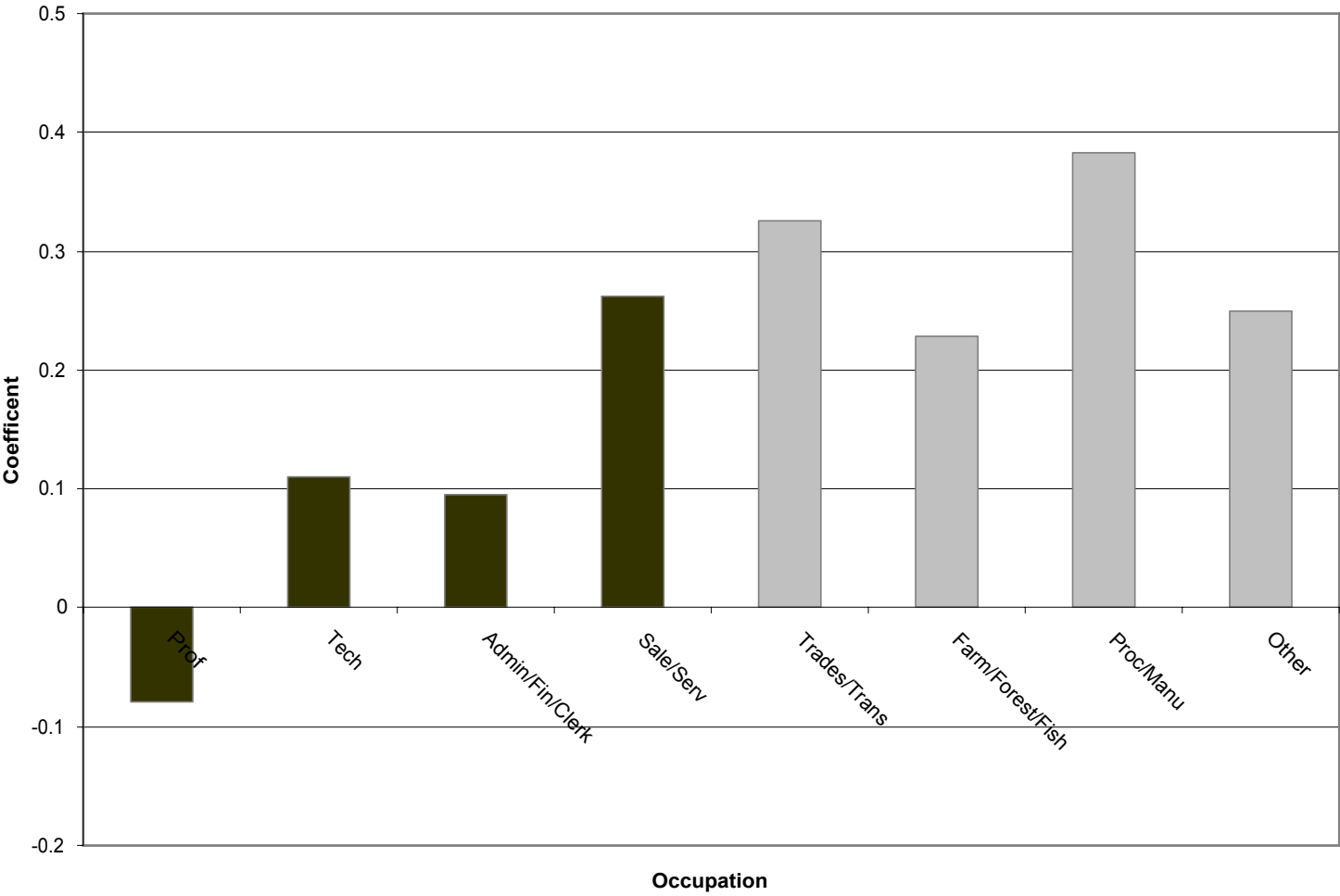


Figure Four: Self Reported Health Status for Men by age for 25th and 75th percentile

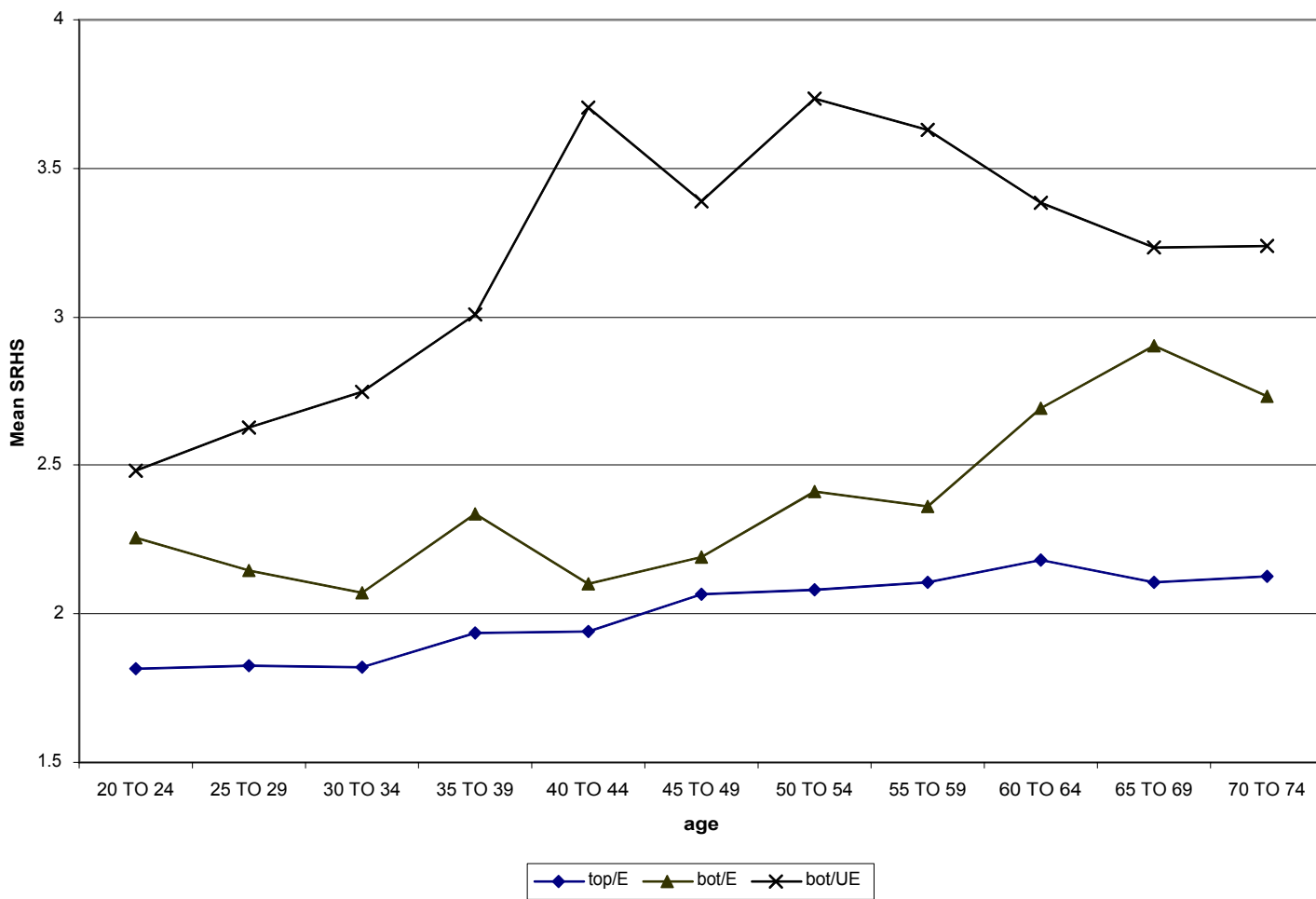


Figure Five: Chronic Conditions by Age, Sex and Occupation

